



# **MARKSCHEME**

**November 2010**

**BIOLOGY**

**Higher Level**

**Paper 3**

1. Follow the markscheme provided, award only whole marks and mark only in **RED**.
2. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded.**
3. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases write a brief annotation to explain your decision. You are encouraged to write comments where it helps clarity, especially for moderation and re-marking. It should be remembered that the script may be returned to the candidate.
4. Unexplained symbols or personal codes/notations are unacceptable.
5. Record marks in the right-hand margin against each mark allocation shown in square brackets *e.g.* [2]. The total mark for a question must equal the number of ticks for the question.
6. Do **not** circle sub-totals. **Circle the total mark** for the question in the right-hand margin **at the end of the question.**
7. Where an answer to a part question is worth no marks, put a zero in the right-hand margin next to the square bracket.
8. Where work is submitted on additional sheets the marks awarded should be shown as ticks and a note made to show that these marks have been transferred to the appropriate square bracket in the body of the script.
9. For each Option: Add the totals for each question in the Option and write it in the Examiner column on the cover sheet.  
Total: Add the marks awarded and enter this in the box marked TOTAL in the Examiner column on the cover sheet.
10. After entering the marks on the cover sheet check your addition to ensure that you have not made an error. Check also that you have transferred the marks correctly to the cover sheet. **All scripts are checked and a note of all clerical errors will be given in feedback to examiners.**
11. If an answer extends over more than one page and no marks have been awarded on a section draw a diagonal line through that section to indicate that it has been marked.
12. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers and use the marks of those answers that have the highest mark, **unless the candidate has indicated the question(s) to be marked on the cover sheet.**
13. A mark should not be awarded where there is contradiction within an answer. Make a comment to this effect in the left-hand margin.

## Subject Details: Biology HL Paper 3 Markscheme

### Mark Allocation

Candidates are required to answer questions from **TWO** of the Options [2 20 marks].

Maximum total = [40 marks]

1. A markscheme often has more marking points than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.
2. Each marking point has a separate line and the end is signified by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing **OWTTE** (or words to that effect).
8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. Indicate this with **ECF** (error carried forward).
10. Only consider units at the end of a calculation. Unless directed otherwise in the markscheme, unit errors should only be penalized once in the paper. Indicate this by writing **–1(U)** at the first point it occurs and **U** on the cover page.

**Option D — Evolution**

- D1.** (a) 11 [1]
- (b) Ile and Glu (*both needed to award the mark*) [1]
- (c) share 17 (out of 29) amino acids in common / more amino acids similar than different;  
both have Mn in the enzyme (as cofactor);  
greatest difference between them is from amino acid 18 to 22;  
mitochondrial has Gly (position 12) while *E. coli* (Mn) never has Gly;  
Leu is most common amino acid in both appearing four times / other valid comparison; [2 max]
- (d) divergent (evolution) as the cytoplasmic dismutase shows a greater number of differences (than the other three enzymes);  
divergent as convergent (evolution) implies existence of analogous structures and there are none here; [1 max]
- (e) endosymbiotic theory states bacteria were engulfed by organisms to become mitochondria;  
sequence comparison between mitochondrial and bacterial dismutase supports this hypothesis;  
more similarity in the amino acid sequence between mitochondrial and bacterial dismutase than between mitochondrial and cytoplasmic dismutase; [2 max]
- D2.** (a) *allele frequency*: measurement of how often an allele appears (*i.e.* A or a);  
*gene pool*: total sum of all the genetic information available for reproduction within the population; [1 max]  
*Both responses are needed to award the mark.*
- (b) large population;  
random mating;  
no migration / immigration / emigration;  
no mutations;  
no natural selection; [1 max]
- (c) phylogeny is the evolutionary line of descent;  
the study of similar molecules in two different species;  $\left\{ \begin{array}{l} (e.g. \text{mitochondrial DNA} / \\ \text{hemoglobin} / \text{Cytochrome } c) \end{array} \right.$   
the greater the differences, the longer the time span since the two species had a common ancestor;  
variation can be due to mutations;  
mutations are chance events so caution must be taken when interpreting these; [3 max]
- (d) organization of data helps to identify organisms;  
suggests evolutionary links;  
suggests the closeness of a relationship the more similar the characteristics are;  
allows prediction of characteristics shared by members of a group; [2 max]

- D3.** fossils being formed is a rare event;  
example to illustrate why forming fossils is a rare event { *(e.g. few Neanderthals survived the event;*  
*cold, so few fossils)*  
fossils being preserved is a rare event;  
fossils being found is a rare event; *(e.g. due to geographical locations)*  
chances of finding fossils is improved by searching in the right geological strata / *OWTTE*;  
poor data / fragmented remains / very small sample size;  
more prone to paradigm shifts/changes in theory when data is limited / discovery of a small amount of fossils can lead to a huge change in theories;  
paleoanthropology can still be considered a science *e.g. Dmanisi, Georgia (falsification of earlier positions held);*

**[6 max]**

**Option E — Neurobiology and behaviour**

- E1.** (a) from 60 to 105 minutes (post-sunset) / 45 minutes [1]
- (b) to increase the possibilities of fertilization [1]
- (c) to avoid interspecific/cross-fertilization;  
cross-fertilization usually not successful/non-productive;  
some overlap of species spawning occurs so temporal separation is not completely successful;  
example of overlap (*e.g. D. strigosa* overlaps with *M. cavernosa*/*M. franksi*); [2 max]
- (d) females always spawned after males suggesting hypothesis correct;  
for example in *M. cavernosa* or *S. intercepta*;  
difficult to tell for hermaphrodites;  
chemical analysis of water should be undertaken after males spawned / other chemical signals / further evidence required to support cause and effect; [2 max]
- (e) the spawning of *D. strigosa* is influenced by male *M. cavernosa*;  
the spawning of *D. strigosa* is influenced by the release of *M. franksi*;  
*D. strigosa* spawning diminishes due to the appearance (spawning) of *M. franksi*;  
light intensity determined; [1 max]
- (f) innate behaviour develops independently of the environmental context / not learned/  
stereotyped / inherited / genetic pre-disposition [1]  
*Do not accept instinct.*
- E2.** (a) a stimulus is a change in the environment that is detected by a receptor and elicits a response [1]
- (b) pressure/movement/sound (detected by) mechanoreceptors;  
chemicals (detected by) chemoreceptors;  
temperature (detected by) thermoreceptors;  
light (detected by) photoreceptors;  
pain (detected by) nociceptors;  
stretch/orientation/movement (detected by) proprioceptors; [2 max]
- (c) impulses passed from pain receptors to sensory areas;  
of the cerebral cortex where pain is perceived / feelings of pain in the areas of the cerebral cortex;  
endorphins act as painkillers;  
which block transmission of impulses at the synapses involved in pain transmission; [3 max]

**E3. *social and genetic: [4 max]***

*genetic:*

genetic link found for (cocaine) addiction;  
difficult to prove / multifactorial;

*social:*

alcohol/other drug problems among family members;  
poor school performance;  
poverty / family conflicts / chaos / stress;  
having friends who drink/use other drugs;  
not fitting in socially / being excluded because of race/ability/ethnicity/gender/age  
/sexual orientation / other factors;

*dopamine and addiction: [3 max]*

substances with addictive potential stimulate the release of dopamine;  
dopamine is a chemical in the brain that is associated with reward and pleasure;  
substance use brings a flood of dopamine, which alters the chemistry of the brain;

**[6 max]**

**Option F — Microbes and biotechnology**

- F1.** (a) *turkeys: 33/32.6/32.56 %*  $\left\{ \begin{array}{l} \text{Both needed to award the mark.} \end{array} \right.$  **[1]**  
*egg laying hens: 0 %*
- (b) none of the egg laying hens have bacteria resistant to 5 or more antibiotics while (10) chickens have bacteria resistant to 5 or more antibiotics;  
 13/65 % of the egg laying hens have no resistant bacteria while 9/20 % of the chickens have no resistant bacteria;  
 both have approximately same percentage/number of *E. coli* resistant to 1 or 3 antibiotics;  
 egg laying hens have less incidence of antibiotic-resistant bacteria than chickens; **[2 max]**
- (c) hypothesis supported for poultry raised for meat but not for egg-laying;  
 turkeys and chickens always have bacteria resistant to more antibiotics than egg laying hens;  
 antibiotic-resistant bacteria are still found in egg laying hens even though antibiotics are rarely given;  
 antibiotic-resistant strains (of bacteria) may have arisen by other means/other than by poultry being given oral antibiotics; **[2 max]**
- (d) from fecal matter to man handling the chickens / by accidental hand to mouth contact / contaminated dust / eating raw meat; **[1 max]**
- (e) inhibition of synthesis of walls;  
 inhibition of protein synthesis;  
 inhibition of nucleic acid synthesis; **[2 max]**
- F2.** (a) (i) *Award [1] for any two of the following.*  
*Rhizobium / Azotobacter / Cyanobacteria / Frankia* **[1]**
- (ii) anaerobic conditions;  
 due to waterlogged soils; **[2]**
- (b) main ingredients are salt, soybeans and water;  
*Aspergillus oryzae/A. oryzae* (or *A. sojae*) added;  
 carbohydrate/starch broken down to glucose/lactic acid/alcohol;  
 proteins broken down to peptides and amino acids;  
 (batch) fermentation;  
 a mash/koji is obtained;  
 pasteurized / preservatives; **[3 max]**



- F3.** example of where this has been used *e.g.* Exxon Valdez spill, Alaska / other correct example;  
indigenous/existing bacteria can break down oil/other correct example;  
bioremediation is the use of nutrients to enhance the activity of existing organisms / the addition of non-indigenous microorganisms;  
converts the toxic compounds (of oil) to non-toxic products;  
bioremediation is used after other cleanup methods have been used;  
bioaugmentation is when bacteria are added to supplement the existing microbial population;  
biostimulation is when nutrients are added to stimulate the growth of the existing oil-degrading/other correct example bacteria;  
bacteria added seem to compete poorly with the indigenous population;  
nutrient concentrations have to be sufficient to support the maximal growth rate of the bacteria throughout the cleanup operation;

**[6 max]**

**Option G — Ecology and conservation**

- G1.** (a) (highest HBR for *Anopheles gambiae*/*A. gambiae* week) 107/108 [1]
- (b) 35 (accept answers in the range of 34 to 37) [1]
- (c) both species show relationship between elevated precipitation and higher HBR (e.g. between week 0 and week 8 / week 100 and week 108);  
there is a lag between the period of precipitation and the increase in HBR;  
sometimes elevated precipitation does not lead to peaks of HBR (e.g. week 27);  
precipitation has a greater effect on *Anopheles gambiae*/*A. gambiae*; [3 max]
- (d) spraying insecticides just before rainy seasons;  
draining swamps before (and after) rain;  
providing (endangered) population with repellents/mosquito nets before rainy season; [1 max]
- (e) temperature / breeding site / food supply / predators / other reasonable answer [1]  
*Do not accept global warming.*
- (f) using natural predators of mosquitoes;  
using natural pathogens of mosquitoes;  
introduction of sterile males;  
setting traps baited with mosquito pheromones/hormones; [1 max]
- G2.** (a) much loss of energy / 80–90 % loss of energy;  
low down food chain so efficient;  
loss of energy through respiration/heat;  
loss of energy through egestion;  
less valuable as a food source than primary producers;  
converts undigestible material into digestible materials; [3 max]
- (b)  $\text{kJ m}^{-2} \text{yr}^{-1}$  / kilojoules per meter squared per year [1]
- (c) ultraviolet/UV light penetrates tissues;  
damages DNA / causes gene mutation;  
can lead to uncontrolled cell division/mitosis;  
stimulates the production of vitamin D;  
stimulates the synthesis of pigments/melanin;  
can cause skin cancer / cataracts;  
affects photosynthesis; [2 max]

**G3.** named example (*e.g. zoo/botanic garden/seed bank/aquarium/laboratory*) /  
definition of *ex situ*;

*Do not accept open parks e.g. Safari.*

*advantages: [3 max]*

prevent extinction / help in conservation of species;

possible breeding;

reintroduction into the wild;

correct nutrition constantly;

veterinary care;

educational use / research use;

prevent poaching/picking rare flowers/damage to habitat by man;

*disadvantages: [2 max]*

difficulty in the reintroduction of the species to the wild;

increases inbreeding / restricted gene pool;

selection of organisms to be kept *ex situ*;

not their natural habitat / reduces evolution;

does not solve the cause/problem *e.g. habitat loss*;

**[6 max]**

**Option H — Further human physiology**

- H1.** (a) for both men and women a decrease is seen at the lowest alcohol intake followed by an increase;  
the level of CRP is higher in women than in men over the range of alcohol consumption / as the intake increases the difference between men and women increases, the CRP increase being greater in women; **[1 max]**
- (b) drinking small amounts of alcohol seems to reduce the level of all markers / drinking none and/or high amounts of alcohol has higher levels of markers than moderate amount;  
the effect of small amounts of alcohol is less in women than in men / the effect of large amounts of alcohol is greater in women than in men / women should consume less than men;  
other effects of alcohol consumption are not measured;  
other factors increasing risk of CVD are not measured;  
the type of alcohol is not stated / the active factor in the drink is not seen; **[3 max]**
- (c) CRP shows the decrease in risk for low amounts of alcohol then increases above the baseline for higher amounts **[1]**
- (d) high blood pressure damages endothelial wall;  
WBC/macrophages build up cholesterol;  
plaque hardens arterial wall / blocks lumen / artery blocked by depositions in wall;  
wall rough;  
clots form; **[2 max]**
- H2.** (a) I. hepatic cells / hepatocytes / liver cells / liver tissue;  
II. hepatic vein / blood cells;  
III. sinusoids; **[3]**
- (b) storage of nutrients;  
detoxification of poisons;  
breakdown of hemoglobin;  
production of bile pigments;  
synthesis of plasma proteins;  
synthesis of cholesterol; **[2 max]**
- (c) *Award [1] for two of the following.*  
cellulose / lignin / bile pigments / bacteria / intestinal cells **[1]**  
*Do not accept fibre.*
- (d) insulin / glucagon / prolactin / somatotrophin **[1]**  
*Award other suitable examples.*

**H3.** *adult hemoglobin: [2 max]*

rapid saturation of oxygen in the lungs;  
rapid dissociation of oxygen as the oxygen concentration decreases;  
oxygen released in the tissues where needed;

*fetal hemoglobin: [2 max]*

fetal hemoglobin curve to the left of adult hemoglobin;  
higher affinity for oxygen than adult hemoglobin;  
oxygen moves from adult hemoglobin to fetal hemoglobin;

*myoglobin: [2 max]*

myoglobin to the left of fetal hemoglobin;  
higher affinity for oxygen than adult hemoglobin;  
only releases oxygen at very low oxygen concentrations/in tissues;  
oxygen reserve;

**[6 max]**

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